

DECONTAMINATION AND DISINFECTION

MONOGRAPH No. 004

NEBRASKA DEPARTMENT OF AGRICULTURE
AGRICULTURAL EMERGENCY RESPONSE ACTIONS
LIVESTOCK DISEASE EMERGENCY



INITIAL ISSUE

August 1, 2005

TABLE OF CONTENTS

1.0	SCOPE AND APPLICATION	1
2.0	SUMMARY OF PROCEDURES.....	1
2.1	Decontamination/Disinfection	2
2.2	Equipment.....	3
2.2.1	Location Criteria	4
2.2.2	Design	5
2.2.3	Methodology	9
3.0	PERSONNEL	17
4.0	BIOSECURITY	18
5.0	HEALTH AND SAFETY.....	19
6.0	COMMUNICATION.....	20
7.0	DOCUMENTATION	20
8.0	TRAINING	22
	REFERENCES	23
	APPENDIX A.....	24
	DISINFECTANTS.....	25
	TABLE (Disinfectants Effective on Viruses).....	28



1.0 SCOPE AND APPLICATION

The purpose of this monograph is to provide functional guidance about the establishment, operation, and maintenance of decontamination and disinfection areas during a contagious animal disease (CAD) outbreak. This monograph also covers biosecurity procedures needed for responders to prevent the additional spread of a CAD. This guidance is compatible with Nebraska's State Emergency Operations Plan (SEOP). Local emergency management should use this monograph as a template. It should be modified as appropriate, and it should be made consistent with the Local Emergency Operations Plan (LEOP). Several sections of this monograph contain general descriptions of the scope of operations necessary to implement a particular component of decontamination and disinfection. In most cases, these sections were made general so local emergency planners could insert or reference more detailed, county-specific operational details. Examples of these sections include Health and Safety and Communication.

2.0 SUMMARY OF PROCEDURES

When responding to a CAD, local responders play an important role in preventing the additional spread of the disease. The actions taken to disinfect equipment, vehicles, and personnel involved in the response will directly impact the ability to quickly contain the disease. This monograph is designed to outline general decontamination and biosecurity procedures. Most of the information covered pertains to any disinfection and decontamination needed; however, this monograph specifically covers special concerns associated with access corridors, mortality disposal, and temporarily housing animals. Please refer to Nebraska Department of Agriculture (NDA) Monographs 001, 002, and 003, respectively, for additional information about these three areas.

Local emergency managers are encouraged to work with local veterinarians when developing county operation plans associated with biosecurity requirements. In addition, the county also can encourage local producers to implement these procedures at their operations.



2.1 Decontamination/Disinfection

Micro-organisms, viruses, and spores associated with the spread of a CAD can spread to non-infected animals in many ways. Many mechanisms for disease spread cannot be controlled by responders; for example, disease spread through the atmosphere via wind. Some mechanisms for spread can be directly controlled by responders. These mechanisms involve the spread of a disease through human and animal movement, the reuse of contaminated equipment, and vehicle movement. CAD agents can be found in the soil, fodder, manure, feed, bedding, and on building surfaces, equipment, animals and in the atmosphere at an infected location. Responders can be exposed to, and become carriers of, the CAD agent by simply being in the atmosphere of an infected location or stepping in, handling, or otherwise contacting materials or objects that are contaminated. Besides being found in visible contamination, such as dirty boots or coveralls, the CAD agents can adhere to clothing, respiratory tract, hair, and skin. Decontamination and disinfection are the tools that responders have to limit the potential for CAD spread outside a quarantine zone.

All vehicles, equipment, and personnel that exit a quarantine area, infected premises, or temporary animal housing facility must be decontaminated and disinfected or their disposable coverings removed and then disposed of. This will be achieved through the physical removal of potentially contaminated materials and through the application of appropriate disinfectant(s). A common problem for all contact disinfectants is maintaining the agent's liquid state on the applied surface. These solutions are generally composed of water, which tends to evaporate prior to the completion of the required contact time. Monitoring of the applied disinfectant and repeated application as it dries can solve this challenge. A general description of common foreign animal diseases (FADs) and possible disinfectants is presented in Table 1.



Table 1
Common Foreign Animal Diseases

Disease	Species affected	Transmission	Best Disinfectant
African Swine Fever	Swine	Ingestion, contact, ticks	A
Influenza (avian, equine, swine)	Birds, horses, swine	Aerosols, ingestion	A
Newcastle Disease	Birds	Aerosols, ingestion	A
Renderpest	Ruminants, cattle	Aerosols, ingestion	A
Peste des Petis	Small ruminants	Aerosols, ingestion	A
Foot-and-Mouth Disease	Cloven hoofed animals	Aerosols, ingestion	B ¹
Swine Vesicular Disease	Swine	Aerosols, ingestion	A
Classical Swine Fever	Swine	Contact, ingestion	A
Porcine Respiratory and Reproductive Syndrome (PRRS)	Swine	Contact, aerosols	A

Notes: Modified from Agriculture and Resource Management Council of Australia and New Zealand, 2000

A Best disinfectants are detergents, hypochlorites, alkalis, Virkon®, and gluteraldehyde.

B Best disinfectants are hypochlorites, alkalis, Virkon®, and gluteraldehyde. Bactericides, like quarternary ammonia compounds and phenolics, are not effective against these viruses.

¹ Acids are effective for foot-and-mouth virus.

The appropriate place to operate and maintain a disinfection station is at an access corridor and at the entrance/exit of disposal areas, infected premises, and temporary animal housing locations.

The equipment, design, and method for implementing personnel, equipment, and vehicle decontamination and disinfection stations are described below.

2.2 Equipment

The equipment needed to supply a disinfection station is presented below. Three distinct classes of decontamination and disinfection equipment are discussed: personal protective equipment (PPE), equipment for decontamination and disinfection, and disinfectants.

- PPE: water, hard hat, safety glasses or face shield, rubber boots, rain suit (jacket and coveralls), cotton overalls or disposable coveralls, disposable synthetic impermeable under gloves (nitrile, latex, etc.), disposable synthetic impermeable over gloves (nitrile, rubber, etc.), heavy-duty over gloves (cotton or leather), boot tray or bucket, one to two gallon hand-operated pressure sprayer, short-handled scrubbing brushes, and heavy duty plastic garbage bags.



- Decontamination equipment: vacuum cleaner, water, high- and low-pressure sprayer, power or fuel for sprayer, plastic sheeting (> 2 mil thick), long-handled scrubbing brushes, sponges, buckets (pet wash), towels (disposable or cotton), heavy duty plastic garbage bags, berming material (e.g., 4x4's, sand, sand tubes, sand bags, etc.), framing materials to build containment structures, sump pump and power supply, drums, or plastic totes to contain spent decontamination, and disinfection fluids.
- Disinfectants: The choice of disinfectants will depend on the particular disease being addressed. State or federal veterinarians could be consulted during the local response planning process to identify specific disinfectants that could be used. Disinfectants can range from dilute solutions of common household products, such as bleach or vinegar to commercially available disinfectants. Broad spectrum disinfectants, such as Virkon® may be an alternative to identifying and stockpiling multiple types of disease-specific disinfectants. In the Australian Veterinary Emergency Plan (Agriculture and Resource Management Council of Australia and New Zealand 2000), many FADs are reviewed and disease-specific disinfectants are presented. Appendix A briefly describes the disinfectants referenced in Table 1.

2.2.1 Location Criteria

The selection of an appropriate area to establish a disinfection station is critical to the successful operation. The operation of the disinfection station should not negatively impact the environment, and its location should provide easy access for residents and responders.

The following is a check list of considerations for selecting an appropriate location for a decontamination and disinfection station:

- Adjacent to or part of an existing traffic-control point.
- Generally, flat terrain that is large enough on either side to house the following: disinfection station, water supply, waste water containment, sanitary facilities, parking for vehicles waiting for disinfection, and those that will not be disinfected. To increase efficiency, responders may not leave the quarantine zone in the same vehicle that transported them through the zone; rather, they will undergo personal disinfection and exit onto the non-quarantine side of the station to acquire transportation away from the response.
- The site should not be located in a sensitive environment (e.g., wetlands, well head protection area, etc.).



- The site should not naturally drain into a sensitive environment such as a wetland, pond, or flowing water.
- The site should have good ground cover to increase infiltration during precipitation and to minimize the potential for creating muddy areas.
- It would be beneficial if the site had access to potable water and a sanitary sewer.
- It would be beneficial if the site were adjacent to an electric power source. The use of a drop service will require coordination with the local power company.
- The site should be on a maintained road, preferably with a concrete or asphalt surface.
- Close to burial trenches, areas where the surface soil is considered grossly contaminated, septic tanks or manure storages so that treated disinfection fluid can be disposed of properly.

The location of a decontamination and disinfection station associated with a temporary animal housing and care area, and with mortality disposal areas, should be at the entrance to the area. This will generally be at a gate or door. This location should be considered a transition zone from potentially contaminated on the livestock or poultry side to “clean” on the opposite side, probably the side where non-contaminated vehicles are parked.

2.2.2 Design

A disinfection station must be designed to provide disinfection at two scales: large scale for vehicles and construction equipment (heavy machinery or construction equipment), and small scale for portable equipment (i.e., cameras, clothing, boots, radios, etc.), and personnel.

Small-scale decontamination and disinfection stations should be setup on an impermeable surface such as plastic sheeting. This will help prevent spent fluids from infiltrating into the soil, help contain the spent fluids, and allow for easier clean-up of the decontamination and disinfection area. The staging of wash/disinfection stations within this area should provide for



gross decontamination and disinfection closest to the quarantine side of the area, leading up to a final rinse at the opposite side of the decontamination and disinfection area, the “clean zone.”

A small scale decontamination and disinfection station should provide mechanisms for removing gross contamination and applying disinfectant to equipment or clothing. This type of disinfection area should have three stations. The first station presents the initial decontamination and disinfection. The second station presents a second disinfection. The third station provides a final rinse.

Tubs are appropriate for equipment that can be submerged, or scrubbed with a disinfectant, such as boots or rain suits. Once the equipment has been thoroughly wetted with the decontamination and disinfection solution, it can be scrubbed with a brush to break up any foreign materials that are adhering to the surface. More delicate equipment that cannot be submerged or is otherwise sensitive to moisture can be sprayed with disinfectant and wiped down with disposable towels. Spraying can be accomplished by putting the decontamination and disinfection solution in a hand-operated sprayer (garden-type sprayer) or through the use of commercial disinfectants in pressurized spray cans. If commercial sprays are used, caution should be taken to select commercial sprays that will not melt plastic or otherwise damage equipment. After a disinfectant is applied, the clothing or equipment should be set aside for a prescribed period of time to allow the disinfectant sufficient contact time to kill the target bacteria or virus. In some cases, it may be necessary to periodically rewet the materials with disinfectant to keep them from drying out.

Once the contact time has been reached for the equipment or clothing decontaminated and disinfected at the first station, it should be moved to the second disinfection station. The same procedures applied at the first station are repeated at the second. After the equipment or clothing, disinfected at the second station, has reached the required contact time, it can be moved to station three where it should be rinsed with clean water. While this rinse water should not contain any live organisms, viruses, or spores, it should be treated in the same manner as the other spent decontamination and disinfection fluids. Decisions regarding the need to



containerize spent fluids from the small scale decontamination and disinfection stations should follow the same rationale as described below for the large scale decontamination and disinfection stations.

Trash receptacles should be placed alongside the first two stations to allow disposable items to be discarded and contained.

The design of a vehicle and heavy machinery decontamination and disinfection station will be dependent on whether or not spent decontamination and disinfection fluid must be contained pending analysis or some other criteria. The chemical make-up of the decontaminant and disinfectant, its biodegradability, the disease(s) being addressed, the amount of organic matter potentially suspended in the spent fluid, and the influence of public perception issues will all be considered when determining the need to contain the spent fluids. This determination should be made through consultation between local Emergency Operations Center (EOC) personnel, the NDA, and the Nebraska Department of Environmental Quality (NDEQ). To facilitate response planning, EOC personnel should work with local veterinarians and State personnel to select appropriate general purpose disinfectants and determine how the spent fluids will be handled.

The vehicle and heavy machinery decontamination and disinfection station should be designed to efficiently deliver and direct a decontamination and disinfection solution to all areas of equipment or vehicles that have been exposed to a contaminated environment. In addition, it will be necessary for the decontamination and disinfection equipment to be able to dislodge soil, bedding, manure, or other potential contaminated matter from the exterior of vehicles or equipment. Generally, this will be accomplished through the use of low-pressure sprayers and scrubbing brushes. If a target disease can spread in an aerosol form, the use of high-pressure sprayers, with water alone, at the access corridor is not recommended. High-pressure water spray into grossly contaminated foreign matter (e.g., soil, manure, bedding, etc.) can move the disease agent into an aerosol form, increasing the potential for spreading the disease. A mix of water and disinfectant should always be used with high-pressure sprayers. Gross contamination should be removed at the farm or location where the vehicle or heavy equipment was grossly



contaminated. The responding lead veterinarian should be consulted prior to establishing the vehicle and heavy equipment decontamination and disinfection station at access corridors. They can assist in determining the risk associated with the use of high-pressure sprayers.

Similar to the smaller scale decontamination and disinfection station, it will be necessary to keep the disinfected areas wet until the appropriate contact time for the disinfectant has been reached. To increase throughput for this stage of decontamination and disinfection, it may help to provide a holding area where disinfected vehicles or equipment can wait until contact times have been reached. This will allow the physical decontamination and initial disinfection to continue at a faster pace.

Generally, it is preferable to set up a large-scale decontamination and disinfection site with the intent to containerize the spent fluids and other matter removed from the vehicles and equipment. This will prevent the work area from becoming a quagmire, and it will help reduce impact on the environment. To do this, it will be necessary to build a bermed area that drains into a corner containing a sump from which the spent fluids and material can be pumped into a holding tank. Berming can be constructed from sandbags, posts, straw bales, or other available material. The berming on the entrance and exit side should be constructed to withstand vehicle or equipment weight or ramps should be constructed to protect the berms at the entrance and exit. This area must be covered with an impermeable material to prevent the fluids from infiltrating into the soil. The dimensions of this containment should be made at least twice as big as the largest vehicle or equipment expected to be disinfected. The additional size will allow adequate working room for decontamination and disinfection personnel.

When dealing with heavy vehicles and equipment, making the area impermeable can be challenging. Initially, the area must be cleared of all loose debris or objects that could puncture any liner material used. In one corner of the area, a sump pit should be excavated. This pit should be large enough to hold a sump pump and 10 to 20 gallons of liquid. The pit should be located along an edge of the area. Building this area on one travel lane of an engineered road will produce a natural drainage toward the edge of the area, assuming the road has the typical



crowning at the center. If the area does not naturally drain to this point, a layer of sand should be put down, with a slope or drainage toward the sump. On top of the soil or sand, one or more layers of plastic sheeting or liner material should be put down to make the area impermeable. Thinner sheeting or liner material will require multiple layers to ensure continued impermeability. To further protect the impermeable layer, plywood sheeting should be placed on top of the material to minimize the impact of vehicles and equipment, and disinfection personnel walking on the material. The heavier the vehicles or equipment, the thicker the plywood needed. Generally, a single layer of 0.5 inch plywood will be appropriate for passenger vehicles. As the size and weight of the vehicles being decontaminated and disinfected increase, thicker plywood or multiple layers of thinner plywood will be required to protect the plastic liner.

Along with this containment base, the large-scale disinfection area will need some form of structure to contain spray drift and splash. This can be assembled by framing a wall around the containment base. The framing should be covered with plastic sheeting to contain the spray drift and splash. This wall should be at least as high as the tallest vehicles being disinfected. The walls on the two ends will need to be moveable to allow vehicles to enter and exit. If high-pressure sprayers are used, these walls may need to be taller to contain the spray drift.

2.2.3 Methodology

When a vehicle or heavy equipment approaches the access corridor from inside the quarantine zone, it will be inspected for external sources of contamination (e.g., manure, mud, soil, bedding, etc.). If the vehicle is grossly contaminated, it will be turned away and the occupants will be directed to return to the place where it became contaminated for decontamination to remove the gross contamination.

If the decontamination and disinfection personnel deem that the vehicle is free enough of contamination to enter the decontamination and disinfection area, it will be driven into the area. At this time, the occupants will be asked to move to an adjacent staging area while the vehicle is decontaminated and disinfected. After the exterior of the vehicle or heavy equipment has been



decontaminated and disinfected, its interior will be inspected for contamination. If necessary, the interior will be decontaminated and disinfected as practical. If the interior or exterior cannot be decontaminated or disinfected to the level required, the vehicle will not be allowed to pass through the access corridor. After the interior and exterior have been decontaminated and disinfected, the vehicle will be moved to a holding area to allow sufficient contact time for the disinfectant to be effective. During this time, the vehicle will be monitored to make sure it does not dry off. If areas are drying, they will be sprayed with disinfectant using hand-held sprayers.

While the vehicle is being decontaminated and disinfected, the occupants will be inspected. The responding lead veterinarian will have developed an exit decontamination and disinfection procedure for residents leaving infected premises, and for any possessions or tools they plan to bring out of the quarantine zone. The occupants will be questioned about their implementation of the lead veterinarian's plan. Boot washes will be available if supplemental disinfection is required. If the occupants have not implemented the lead veterinarian's plan, they will not be allowed to pass through the access corridor until they have followed the exit plan developed by the lead veterinarian. A typical plan might include the following procedures for personal disinfection, particularly if there has been contact with livestock or contaminated areas.

Residents whose livestock or property is contaminated and responders who become grossly contaminated will need to wash and disinfect themselves and their clothing before they leave the infected premises. Showering and changing into clean clothing may be acceptable for residents not associated with infected premises, but inside a quarantine area. Use of the following substances as personal disinfectants can be recommended where no other approved disinfectant is available:

- Domestic washing soda (10 parts in 100 parts hot water)
- Soap (or household detergent) and hot ($\geq 140^{\circ}\text{F}$) water for scrubbing



- Household concentrated chlorine bleach (1 part in 3 parts water to give 2 to 3% available chlorine). **This must not be used on hands, face, or skin.**

Personal Decontamination/Disinfection

The following procedures can be used for response personnel and residents of infected premises before leaving a quarantine area. On arrival at the disinfection station, a disinfectant solution, safe for skin contact, should be ready in buckets and sprayers. Since there are no antiviral disinfectants that are both effective against all virus families and approved for use on human skin, a warm, soapy water is recommended for washing face, hair, skin, etc. To increase the virucidal effect of this type of solution, the pH can be raised by adding sodium carbonate or lowered by adding acetic acid. The direction of the pH shift will be determined by the virus in question. If other skin decontaminants are used, responders must be sure they are effective virucides for the target virus. Heavy duty plastic garbage bags should be used for disposable items or for items to be removed from the site for further disinfection and cleaning.

Reusable clothing, such as rain suits, can be decontaminated and disinfected at this station by using a combination of a sponge, scrubbing brush, and a low-pressure sprayer. These items in combination with the appropriate disinfectant should be used to wash the clothing thoroughly, removing gross contamination. This cleaning must target the entire garment, including areas under the collar, zips and fastenings, and the insides of pockets. In most cases, jackets, pants, and boots will have the disinfectant applied through immersion in a disinfectant solution. A sprayer would be appropriate if an initial decontamination and disinfection was needed prior to doffing the protective clothing. In this case, the clothing would be grossly contaminated with organic matter. If underclothing has been contaminated, especially above boot level, it must be removed and placed in a plastic bag, the skin washed, and a clean pair of overalls used for leaving the site.

Reusable clothing, such as coveralls, can simply be removed, soaked in disinfectant, squeezed out, and placed in a plastic bag for disposal. Underclothes and rubber boots should be similarly



treated. Plastic bags containing used clothing should be sealed, wiped down with a disinfectant, and placed at the outer limit of the area for collection by courier for laundering. It is best if reusable clothing are disinfected and laundered at the access corridor.

Disposable clothing (i.e., Tyvek® coveralls and gloves) and equipment should be removed and directly placed in plastic bags for disposal.

Once contaminated outer clothing has been removed, personnel should then shower with an appropriate disinfectant, exiting the shower into a “clean” area where clean clothing and footwear is available. After putting on the clean clothing, the personnel can leave the area.

Decontamination/Disinfection in Emergency Medical Situations

The need may arise to initiate an emergency transport of personnel out of a quarantine area, for example, in the event of a medical emergency or injury. The level of initial decontamination and disinfection of a person injured will vary with the seriousness of the injuries. Human life is a priority and every measure must be taken to minimize discomfort or pain. If decontamination and disinfection procedures, for the personnel and vehicle must be abbreviated due to the extent of an injury or medical condition, the risk of spreading a disease could be great. In this case, the EOC should be notified. The EOC should then notify the appropriate hospital authorities of the risk and of the appropriate personal disinfection for the patient and vehicle, which should be carried out as soon as circumstances permit. The vehicle (e.g., ambulance wheels, underside, and interior) should be washed with approved disinfectant, at a minimum, as the vehicle leaves the access corridor. Personal clothing and boots of the emergency personnel should be removed for cleaning and disinfection if they had to enter the quarantine area. Disposable clothing can be worn by the emergency personnel and the victim to minimize the potential spread of contamination. The disposable clothing worn by the responders and the victim should be disposed of and secured in plastic bags and any clothing or equipment thought to be contaminated should be disinfected.



Vehicle and Heavy Equipment Decontamination/Disinfection

The following procedures can be used to decontaminate vehicles and equipment (i.e., cars, livestock carriers, feed trucks, milk trucks, carcass transporters, airplanes, etc.) that leave a quarantine area. All of these vehicles have the potential to spread a contagious disease out of the quarantine area. If at all possible, the movement of vehicles out of a quarantine area should be minimized. Clean vehicles should be available for responders to use after they have undergone the personal decontamination/disinfection described above.

Cars, pickup trucks, and other personal use vehicles can be decontaminated and disinfected using the following procedures. All floor mats should be removed for scrubbing with disinfectant. The inside of the vehicle that has had contact with passengers or the driver (e.g., dashboard, steering wheel, handbrake, gear shifter, and seats) should be wiped liberally with appropriate disinfectant. If the trunk or bed of a truck is considered contaminated, the contents must be removed and the interior of the trunk or truck bed wiped with disinfectant. The contents of the trunk or truck bed must be disinfected before being replaced, or they can be left in a secure location inside the quarantine area. The wheels, wheel wells, and underside of the car should be sprayed with disinfectant and all foreign material (e.g., soil, manure, bedding, etc.) must be removed. In some cases, it will be necessary to decontaminate and disinfect the entire outside of the vehicle if it is visibly contaminated or it has come from infected premises.

Plain water should not be used with high-pressure sprayers, because the process could release mist and aerosols containing the virus. This can lead to the spread of disease. A mixture of disinfectant and water should always be used with high-pressure sprayers. Generally, decontaminating and disinfecting grossly contaminated vehicles should only be done on the premises where they became contaminated. Doing this gross cleaning at the access corridor raises the possibility of unintentionally spreading the disease.



Decontaminating and disinfecting grossly contaminated vehicles by brushing with a combination of a disinfectant and soap, to dislodge encrusted dirt and organic matter, is preferable to washing with high-pressure water streams.

Vehicles used to transport livestock and poultry will need to be decontaminated and disinfected if they are to leave a quarantine area. The gross decontamination and disinfection should not be carried out at an access corridor; rather, it should be conducted at the location where the trailer is unloaded, inside the quarantine zone. The gross decontamination and disinfection should involve removing all foreign matter (e.g., soil, manure, bedding, etc.) from trailers and bodywork. Vehicles should then be soaked in disinfectant and scrubbed down to bare metal, painted surfaces or wood with a detergent and disinfectant. Fixtures and fittings should be dismantled to ensure that infected material has been removed. Wooden surfaces must be cleaned and disinfected, where appropriate, before removal and disposal. When the crate structure of a trailer has been decontaminated, it should be lifted, if possible, from the chassis so the undersides and mounting points can be decontaminated. Livestock or poultry transport vehicles must be closely inspected to check whether there are double layers of metal or wood used in their construction. If there are two layers, the top layer should be removed to reach areas where contaminated material could be trapped. Any metal flooring that appears solid should be checked to be sure there is no foreign material under the flooring. Some trailers may carry extra equipment under the chassis; this must be treated. Outer wheels and spare wheels must be removed to ensure adequate decontamination and disinfection and to inspect the spare wheel hangers, which can be hollow, creating a potential to contain contaminated material.

The driver's cab and, where fitted, the sleeping compartment must be thoroughly decontaminated and disinfected. The driver should be questioned as to the disposition of clothing and boots worn when in contact with diseased livestock or poultry. This clothing should be decontaminated and disinfected.



Specialized stock vehicles may carry their own water, food, and litter supplies for the animals. Water, feedstuff, and litter carried in the vehicles must be disposed of. Burning or burial are common methods of disposal for these materials.

If dairies are situated in the quarantine area, it may become necessary to decontaminate and disinfect milk trucks if it is essential for them to leave the quarantine area.

Disinfectants used to decontaminate and disinfect the inside of the tank must not leave a chemical or taste trace. If a tanker is carrying infected milk, the volume of milk must be determined and the milk mixed with the correct strength of disinfectant. It must be left standing for the appropriate contact time and then disposed of appropriately. The appropriate disposal of contaminated milk, if relevant to the county, should be determined in the emergency planning stage of response preparedness. The exterior and interior of the tanker must be decontaminated, along with all hoses and fittings. The procedures for general decontamination and disinfection follow the procedures discussed for livestock and poultry transport vehicles.

Feed trucks may need to enter and exit a quarantine area to service non-affected species or to service livestock or poultry that has not been confirmed infected. If it is necessary to allow a feed truck into a quarantine zone, a specific route should be planned to minimize the contamination of the vehicle. Wherever practical, animal feed should be delivered to the outer limits of a property and then transferred to the animals, so the vehicle and driver do not become grossly contaminated. The vehicle and driver must be thoroughly decontaminated before being allowed to leave. Feed truck decontamination and disinfection will follow the procedures discussed for livestock and poultry transport vehicles. In addition, residual feed in the vehicle must be sprayed with disinfectant and removed for disposal. The insides of bulk trailers should be decontaminated with approved disinfectant.

If a quarantine zone encompasses an airport, potentially contaminated aircraft should be decontaminated and disinfected before they are allowed to leave the area. Aircraft construction prohibits the use of strong alkaline disinfectants, including as caustic soda, because of corrosion



problems with metals, such as aluminum. A mild alkaline disinfectant, such as sodium carbonate, can be suitable for use on aircraft. Care is required when disinfecting specialized equipment in the aircraft.

Heavy machinery used on a contaminated site will be grossly contaminated. Machinery may include: excavators and backhoes, bulldozers, front-end loaders, forklifts, tractors/trailers, dump trucks, fire truck (incineration), roll-offs, cranes, chains, hooks, shovels, cargo nets, etc. This equipment must remain on the contaminated site until needed elsewhere. For example, once carcass disposal has been completed, this machinery must be decontaminated and disinfected prior to moving to another site within the quarantine zone. This gross decontamination and disinfection should follow the guidelines discussed above for livestock and poultry transport vehicles, but this should be conducted at the contaminated site where the equipment had been used. When a vehicle has undergone gross decontamination and disinfection and it needs to be moved out of the quarantine zone, it should be moved to the access corridor for final decontamination and disinfection.

Portable Equipment Decontamination and Disinfection

If electrical equipment, such as generators or motors, must be moved out of a quarantine area the following procedures can be used. If there is doubt, consult an electrical contractor. Consider whether decontamination of this type of equipment is a priority. It is unlikely that covered electrical equipment will be heavily contaminated. These items are best considered at the end of the decontamination process, when specialists can be more readily consulted.

The most practical method of decontamination involves placing the equipment inside an airtight enclosure, possibly constructed from plastic sheeting, for fumigation. If the equipment can be easily dismantled, it should be, and all of its parts should be placed in a small enclosed space for fumigation. Some electrical items may be inherently airtight, in which case they can be safely decontaminated and disinfected by wiping down with disinfectant. A possible fumigant is formaldehyde gas. Serious consideration must be given to the practical and safety aspects of this



procedure. It is important to remember that most viruses will inactivate spontaneously with time. Exposure to the ultraviolet light in sunlight may be another option for disinfecting complex equipment.

Hand-held radios, cameras, tape recorders, and clipboards are a few of the portable types of equipment that will be used inside a quarantine zone. All of these items can be used while protected inside plastic bags. Inexpensive waterproof cameras can be used to record response actions. The waterproof nature of the camera will allow it to be disinfected. When it is necessary to remove this type of equipment from a quarantine zone, the following procedure should be carried out at the small-scale decontamination and disinfection station at the access corridor:

- Wipe protective plastic bags with disinfectant and discard them;
- Wipe the body of the equipment with disinfectant; and
- Replace equipment in a clean plastic bag for removal.

There is a small residual risk of contamination; therefore, these items should only be used in a specific quarantine zone for the duration of the outbreak.

Equipment used to euthanize livestock (i.e., captive bolt guns and firearms) will generally be considered to be grossly contaminated. After use, these devices should be scrubbed with disinfectant at the location where they were used and again at the access corridor.

3.0 PERSONNEL

Decontamination and disinfection are the tools responders have to limit the potential for CAD spread from infected animals. In addition, the potential for contamination will be greatly reduced if only essential personnel and equipment are brought into the temporary housing and care area. To reduce the decontamination and disinfection necessary at these sites, vehicles should not be brought into the site.



Generally, staff working at decontamination and disinfection sites will require training in the following areas: operation and maintenance of disinfection or decontamination stations, biosecurity, and FAD. Training in the latter two areas can be provided by local veterinary staff. The training will allow these personnel to make informed decisions regarding the need for and adequacy of disinfection, and the background to identify possible disease spread vectors inside vehicles or otherwise associated with the travelers.

Often, local fire and rescue personnel have had training in decontamination and disinfection. Other personnel may be obtained from the following organizations: county roads, public works department, Nebraska Department of Roads, the Nebraska National Guard, local citizen's corps, or other organizations with appropriately trained personnel.

4.0 BIOSECURITY

In order to preserve herd or flock health and prevent the spread of disease, local emergency planners should develop biosecurity guidelines for temporary livestock and poultry housing and care areas. All personnel associated with creating, operating, and maintaining these areas should be required to conform to the county's biosecurity guidelines. Possible biosecurity guidelines should include the following:

- Workers may be required to wash and disinfect their vehicle or tires prior to entering the temporary housing and care area. State or federal veterinarians should be consulted on the need for this level of biosecurity.
- Workers should be required to sign in, in order to log all visitors that enter the temporary housing and care area.
- Workers should be required to maintain a 48-hour animal-free period prior to entering the temporary housing and care area. Visits to state fairs, zoos, and other places where animals are housed must be figured into the animal-free day calculation. In the case of poultry, response personnel must eliminate contact with pet birds (even being in the same house), or other bird gathering areas, such as feeders. Depending on the species involved and the potential risk, these animal-free periods can be modified, especially if unique crews can be assigned to each area.



- Workers should be required to wear clean clothes, typically including coveralls, head covering, and boots.
- Workers may be required to shower before entering and prior to exiting the temporary housing and care area. If this is done, local emergency planners must plan for the supplies and equipment necessary to provide this option.
- Workers should disinfect portable equipment prior to entering the temporary housing and care area.
- Workers should not wear jewelry into the temporary housing and care area.
- Workers should work on animals from areas of youngest animals to oldest animals when phases of production are collocated at a temporary housing and care area. Veterinarians should be consulted on this order for the various species considered.
- Workers should utilize boot disinfection solutions provided at the temporary housing and care area.

5.0 HEALTH AND SAFETY

General first aid and access to emergency medical services must be provided at all traffic control locations that are staffed. This portion of a response would be coordinated by the Safety Officer, a member of the Command Staff supporting the Unified Command.

Decontamination and disinfection area personnel should be provided PPE to minimize their exposure to contaminated materials. Unless stipulated by the lead responding veterinarian (possibly a position added to the Command Staff), respiratory protection is probably not necessary. Decontamination and disinfection workers should wear waterproof clothing or rain suits, with hoods, that can be disinfected and reused. Rubber gloves and rubber boots will also be needed. These items can be disinfected and reused. Under gloves, cotton or nitrile, should be worn under the outer rubber glove. The personnel also should wear hardhats fitted with face shields to protect their faces. In addition, dust masks can also be worn to protect the workers' mouths and to prevent ingesting splashed materials.



6.0 COMMUNICATION

Due to the dynamic nature of an emergency response to a CAD, the establishment and maintenance of decontamination and disinfection facilities must be coordinated with the ever-changing understanding of the nature and extent of the disease in question. In order to allow the teams in charge of the decontamination and disinfection areas to quickly respond to changing field conditions communication between the teams and the EOC must be maintained. Real-time communication and pre-shift meetings constitute the required communication needed to support decontamination and disinfection areas.

7.0 DOCUMENTATION

Throughout the process of conducting decontamination and disinfection, it will be necessary to provide various types of documentation. For indemnity payments to the responding agency or other forms of state or federal reimbursement or cost sharing, it will be necessary to document the resources applied and expended in decontamination and disinfection. These costs can include labor charges, equipment rentals or purchase, costs of expendable equipment or supplies, subcontractor costs, or any other costs associated with providing the decontamination and disinfection services.

Because of the nature of an emergency response, it is critical to identify personnel who will have the responsibility of documenting these issues or monitoring and verifying that the needed documentation is being collected by other parties. In some cases, identifying a specific response job that includes documentation will be preferable, especially if personnel will be rotated through shifts and response jobs. This role and responsibility should be identified and described in a county's LEOP.



Possible actions or items that should be included in a documentation checklist include:

Responder time (hours)	Meals provided
Number of responders	Location of each responder
Identity of responders	Equipment at each point
Sanitation services provided	Usage time for equipment
Water provided	Specific quantities of expendables used
Number of people/vehicles decontaminated	

Documentation will also be essential to tracking vehicles, heavy equipment, and people who exit and enter the area.

Documentation should be maintained in written form. Video, photographs, and tape-recorded messages can be used to supplement the written documentation. Written documentation can be maintained in a logbook format, using documentation worksheets, or a combination of both. Documentation should be recorded with an ink pen, and any entry errors should have a single line drawn through them with the author's initials and date recorded at one end of the line. If a logbook is used, it should have numbered pages and the spine should be sewn, making the removal of pages both difficult and obvious. Pages should never be removed from a logbook. Anyone making entries in the logbook should sign and date the bottom of each page. If documentation worksheets are used, the author should sign and date the bottom of each worksheet. Sets of logbooks and worksheets should be assigned to each response task (i.e., traffic control, decontamination/disinfection, mortality disposal, etc.) or a master set of logbooks and sheets can be maintained. Logbooks and worksheets should be assigned unique identification numbers. When the logbooks or a group of worksheets is issued from the EOC to a responder, the identification numbers of the logbooks and worksheets should be recorded and the recipient should sign them out in a document-tracking log maintained by the EOC. This establishes a chain-of-custody for the documentation.

If pictures, video, or taped messages or interviews are used to supplement the written documentation record, the following information should be documented for each picture, video segment, or audio-taped message or interview: photographer or interviewer, subject, time, date, person interviewed (video or audio-taped), photo and film roll number, direction (pictures and



video), and general weather conditions (i.e., temperature, wind direction, humidity, sky condition, etc.).

8.0 TRAINING

Personnel staffing the decontamination and disinfection station would benefit from training in: the operation and maintenance of the decontamination and disinfection equipment, disinfection procedures, associated environmental protection issues; and the inspection of people, vehicles, pets, and other possessions prior to crossing the access corridor. The latter training will require basic training in biosecurity and FAD. Some of these requirements are addressed in NDA Monograph No. 003 *Temporary Housing of Livestock and Poultry*, Section 2.3. Qualified state and federal employees could be utilized to develop and provide this training for responders that might be assigned these tasks.



REFERENCES

- Agriculture and Resource Management Council of Australia and New Zealand. (2000).
AUSVETPLAN 2000 Operational Procedures Manual Decontamination.
- Bayer (1998). Foreign Animal Disease – The Gray Book. Committee on Foreign Animal
Diseases of the United States Animal Health Association.
- Nalepa, Chris J. (2000) Oxidizing Biocides: Properties and Application, Analyst Spring.

Initial materials for this Monograph were furnished by SES, Inc., as part of work performed for the Nebraska Department of Agriculture under a grant from the Nebraska Emergency Management Agency.



APPENDIX A

DISINFECTANTS

Table 1 presents some common FADs that could be encountered during an emergency response to a livestock or poultry disease outbreak. This Appendix presents a brief description of the classes of disinfectants mentioned in Table 1, and other information, such as general contact times. This information was adapted or modified from the AUSVETPLAN 2000 (Agriculture and Resource Management Council of Australia and New Zealand, 2000). Table 2 summarizes the information presented below. Some chemicals in the list below are hazardous and will require special precautions. These chemicals should only be used under the supervision of properly trained personnel.

Soaps and Detergents

Soaps and detergents are commonly used to clean the surfaces of contaminated equipment or clothing. Often their primary function is to remove organic matter, soil, grease, and other surface contaminants. The use of hot water and physical abrasion (scrubbing) will enhance the soap or detergent's ability to remove contaminants. The surfactant action of soaps and detergents effectively removes most Category A viruses from contaminated surfaces.

Many commonly used disinfectants associated with hospitals, dairies, and food processing areas involve soapy combinations of phenolics or quaternary ammonia compounds. These agents are bactericides; however, they have limited use as virucides. While these materials could be used in preparatory cleaning and decontamination, better bactericides and virucides are available that will decontaminate and disinfect at the same time.

Oxidizing Agents

These agents are commonly recommended as disinfectants for many applications. A common oxidizing disinfectant is liquid bleach or chlorine powder for swimming pools (sodium hypochlorite). In a bleach solution, chlorine is released and is a powerful oxidizing agent and

capable of killing all virus groups (Nalepa, 2000). Studies have shown that sodium hypochlorite solutions of around 0.18% provide an effective broad spectrum biocide. The effectiveness of these solutions is optimal in the pH range of 6-9. As the concentration of organic matter increases in the solution, the effectiveness of the solution as a biocide is reduced. Effective hypochlorite disinfecting solutions can be made from household bleach or chlorine powder used to maintain swimming pools. These solutions are negatively impacted at temperatures above 60°F; they rapidly decompose and lose effectiveness as a biocide.

Virkon® is a commercially available oxidizing disinfectant that incorporates a high percentage of surfactant. This yields a good cleaning/decontamination product with virucidal properties. This material is reported to have low environmental toxicity and to be effective against all 17 virus families. This material is not approved for use on skin.

Alkalies

High pH materials, alkalies, are effective disinfectants. Common alkalies include sodium hydroxide (caustic soda) and sodium carbonate (washing soda). These agents are low cost and have a natural saponifying action on fats, which can help in the decontamination process. These materials are virucidal, and they maintain their effectiveness even with high concentrations of organic matter. These agents are often used for the disinfection and decontamination of penning, buildings, and manure pits associated with livestock or poultry production.

Acids

Acids can be used as virucides. When using an acid, it is important to match appropriate acid or mixture with the virus being treated. These agents can be useful in disinfecting a broad range of materials from liquid effluent to personal decontamination. Citric acid and acetic acids are weak acids that can be useful against many acid-sensitive viruses (e.g., Foot-and-Mouth Disease) and it is mild enough to be used on clothing and for personal disinfection. In some applications,

acids can be added to detergents to combine the decontamination power of the detergent with the disinfecting ability of the acid.

Aldehydes

Gluteraldehyde is a virucide that is effective against all virus families and many other organisms. This agent can be effective at concentrations of 2% and its effectiveness is reduced as concentrations of organic matter increase. Recent studies have suggested possible negative long- and short-term health impacts associated with the inhalation of gluteraldehyde vapors.

Formalin is another aldehyde that is used as a virucide. A 40% aqueous solution of formaldehyde gas is an effective disinfectant. A 1:12 dilution of formalin in water produces an 8% solution that is effective against most virus families, but not against scrapie or bovine spongiform encephalopathy.

Table 2
Disinfectants Effective on Viruses

Disinfectant Group	Form	Strength	Contact Time (minutes)	Applications
Soaps and Detergents	Solids or liquids	As appropriate	10	Cleaning and decontamination. Can be used on Category A viruses (i.e., lipid containing virus).
Oxidizing Agents				
Sodium hypochlorite	Concentrated liquid (bleach)	1:5 dilution (2-3% available chlorine), 1 fl. oz. of household bleach per gallon of water	10-30	Use for most viruses, loses effectiveness as organic matter concentrations increase, rapidly decomposes at temperatures >60°F.
Calcium hypochlorite	Solid	4 oz. per gallon (2-3% available chlorine)		
Virkon®	Powder	3 oz. per gallon (2% weight (w)/volume (v))	10	Active against all virus families.
Alkalis				
Sodium hydroxide	Pellets	3 oz. per gallon (2%w/v), or a 2% solution can be made by mixing 1/3 cup of pellets per gallon of water	10	Very effective on most viruses. Not compatible with aluminum or aluminum derived alloys.
Sodium carbonate	Powder (anhydrous)	6 oz. per gallon (4% w/v)	10	Good when high concentrations of organic matter are expected.
	Crystals (hydrated)	14 oz. per gallon (10% w/v)	30	
Acids				
Acetic	Liquid (vinegar is 4 to 8% acetic acid)	4 to 5 % (6.5 fl. oz. of glacial acetic acid per gallon of water)	Not listed	Not a broad spectrum virucide (e.g., effective for Foot-and-Mouth).
Citric	Powder	¼ oz. per gallon (0.2% w/v)	30	
Aldehydes				
Gluteraldehyde	Concentrated solution	As appropriate (2% w/v)	10-30	Effective against most viruses.
Formalin	40% formaldehyde	1:12 dilution (8% v/v)		Releases irritating and toxic gas.

(Modified from Agriculture and Resource Management Council of Australia and New Zealand, 2000; and Bayer 1998))